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Shocks and fish stocks: The effect of disasters and policy announcements on listed fishing companies' market value

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Abstract

We investigate the effect of disasters and fisheries policy announcements on the value of large fishing companies. These companies are highly relevant for global fish production and marine ecosystems. Financial markets reveal how investors perceive and appreciate news about disasters and policy announcements. This can affect the financial value of the fishing companies. We use a sample of 87 events and investigate how shocks affect the market value of 42 firms. It shows that earthquakes significantly affect fishing companies' market returns. Further, it shows that listed fisheries are especially sensitive to disasters and that earthquakes have more pronounced effects than oil spills. Other event types trigger marginally significant responses or none at all.

KEYWORDS

disaster, event study, firm performance, fisheries, keystone companies, policy announcement, stock market returns

1 | INTRODUCTION

Both ecosystems and businesses are sensitive to shocks. For marine ecosystems and fisheries, Lindegren and Brander (2018) discuss the impact of environmental shocks. Examples are fishery collapses, natural disasters, oil spills, policy changes, aquaculture disease outbreaks, and price spikes. Disruptions and conflicts may affect consumers (Block et al., 2004), fishers and fisheries (Brewer, Cinner, Fisher, Green, & Wilson, 2012), markets (Belz & Schmidt-Riediger, 2010; Pavlovich & Akoorie, 2010), supply chains (Lim-Camacho et al., 2017), and ecosystems (Smith et al., 2017; Søgaard & Madsen, 2007), as well as financial investors (Jouffray, Crona, Wassénius, Bebbington, & Scholtens, 2019). It is the latter stakeholder we are primarily interested in. In this regard, we focus on fisheries. The Food and Agriculture Organization (FAO) (2016) estimates that the economic impact of such hazards on the fisheries and aquaculture sector in the period 2003–2013 was about 1.7 billion US dollars.

Several studies investigate how shocks influence the fisheries (e.g., Armengol, Castillo, Ruiz-Mallén, & Corbera, 2018; Brewer et al., 2012; Crona, Van Holt, Petersson, Daw, & Buchary, 2015; Ward, Possingham, Rhodes, & Mumby, 2018). Leadbitter and Benguerel (2014) study how tuna fisheries try to cope with sustainability. An alternative approach is to evaluate the effect on stock prices of listed fisheries (please realize that the word stock in this paper exclusively relates to the shares of the company, not to marine resources) and hence their market value. Listed companies in marine fishing and aquaculture are large-scale companies with high relevance for world fish production and its environmental and social impact as they show to dominate catch and processing in most commercial species (Österblom et al., 2015). These companies are not representative for the fisheries as a whole, but they dominate the industry (Jouffray et al., 2019). They have the unique ability to capitalize and monopolize marine resources (see Blasiak, Jouffray, Wabnitz, Sundström, & Österblom, 2018). By studying how their investors respond, we

analyze the effect of disasters and policy change announcements on firm value. We also investigate whether particular event or firm characteristics are relevant in this regard.

By focusing on stock prices and returns, we relate to the role of investors. Galaz, Crona, Dauriach, Scholtens, and Steffen (2018) show that equity investment is a crucial means for leverage, especially in relation to environmental and social change. Shareholders have strong and clear (pecuniary) incentives to process information that is relevant for firm performance. However, because of investor myopia, this pricing need not necessarily be efficient from an economic, environmental, or social perspective (Mayer, 2017). Finance theory assumes that a firm's expected profitability is reflected in its stock price. It also assumes that all new information immediately translates into the pricing of firms' financial assets. Events that affect profitability will affect the stock price and, hence, the market value of the firm (defined as the firm's stock price times the number of stocks in circulation). Unexpected changes in stock returns related to a specific event inform about market expectations regarding the impact of this event. As such, the market response to a particular event informs about the value relevance and the viability of the firm in relation to this event (Malkiel & Fama, 1970). In finance, it is a black box as to how exactly the investment community arrives at their decision; the overall process is directly reflected in the financial markets, which yields equilibrium outcomes (Malkiel & Fama, 1970). Thus, stock prices and stock market value inform about the perception of the investment community regarding the financial value of fisheries companies and their growth opportunities. If different categories of events have different impacts on fishing companies' stock returns, abnormal stock market returns inform to which event types firms might be most sensitive in terms of firm value and business viability. The finance approach is widely used to assess the impact of very different events on firm and industry performance (e.g., McWilliams & Siegel, 1997). As the performance of large companies translates into their stock market performance, this perspective informs the fisheries industry and audience. Further, it is important to realize that the valuation of firms influences their cost of equity capital and as such their finance and investment decisions.

This paper aims to contribute to a better understanding of the sensitivity of the fishing and aquaculture industry to global environmental change. We do so by examining the effect of disruptions and conflicts on the value of the dominant fishing companies as measured by their stock returns and by taking the shareholder perspective. The FAO's (2016) assessment focuses on the impact of disasters in a very generic way, and Gephart, Deutsch, Pace, Troell, and Seekell (2017) investigate very heterogeneous disturbances. We aim to complement the literature by examining earthquakes, oil spills, and positive and negative policy shocks along different firm attributes (see also Karman, 2020; Lindegren & Brander, 2018). We divide them in distinct groups and investigate the response of financial investors. The objective of this study is to test whether shocks influence listed fisheries' market value. If so, investors regard large fishing companies to be sensitive to such shocks.

The following section provides the materials and methods of this study. Section 3 discusses the findings and their implications. Section 4 concludes.

2 | METHODOLOGY AND DATA

To assess the impact of disasters and policy announcements on fishing companies' stock market returns, we use two types of data. First, we compile a sample for both categories of events and their characteristics; this is detailed below. Second, we collect data for all listed fisheries to allow for the event-study analysis, which requires stock market information. We detect 42 listed fisheries (see Appendix D). Half of these are listed at the Tokyo Stock Exchange in Japan. Norway is the country that ranks second in this regard with six listed companies, and Chile ranks third with three companies. In total, the listed fisheries are from 12 countries. Two thirds of the sample firms have a listing on an Asian stock exchange, and about one fifth of the sample firms have so in Europe. The remaining 10% is listed on an American exchange.

To allow for replication of the sample, we require that the events are selected with the help of clear criteria (Brown & Warner, 1980, 1985). To this extent, we use the following qualifications to include an event in the sample (Gephart et al., 2017; MacKinlay, 1997). For natural disasters, we require the event occurred on a specific date; this ensures the applicability of the event-study method. Further, the event occurred in a country that borders an ocean, sea, or lake larger than 50,000 km^2, to ensure that disasters have a potential direct impact on fishing companies. Third is that the event resulted in damages of over 25 million US dollars, adjusted for inflation, to ensure that disasters are significant enough to potentially have an impact on fishing companies' returns. With respect to policy announcements, we also require a specific date of occurrence. Further, the event constitutes a change in policy that aims to regulate the fisheries and is acknowledged and/or reported by a government or (inter)national organization with legislative and/or executive competence in the fisheries and aquaculture sector. This ensures that policy announcements are significant enough to influence the fishing companies' stock returns and that their existence is verifiable. The value of a firm derives from all its activities and operations (Malkiel & Fama, 1970). An event may affect a firm's operations in some locations, but not everywhere. The research design of the event study allows us to conclude whether or not a particular event has a significant influence on firm value (Brown & Warner, 1980).

We select disasters from worldwide significant natural hazard databases provided by the US National Oceanic and Atmospheric Administration (NOAA, 2019; https://www.ngdc.noaa.gov/hazard/), which contain global data on earthquakes, tsunamis, and volcanic eruptions and oil spills from International Tanker Owners Pollution Federation (ITOPF, 2019; https://www.itopf.org/knowledge-resources/data-statistics/statistics/) and the Accidental Oil Discharges from United Nations Environmental Programme (UNEP, 2019; http://oils.gpa.unep.org/facts/oilspills.htm). To select policy events, we consult

press releases by the fisheries department of the European Commission and the fisheries department of the NOAA. Both organizations not only report on fishing events from their respective regions but also report on significant fishing events from around the world. As a result, we end up with 87 events for the period 1989–2016. This relates to 46 disasters and 41 policy announcements. The list of events and event dates is in Appendix A. Appendinces B and C detail the disasters and policy announcements, respectively. For the announcements, we qualify the exact policy as well as whether it is reckoned as positive or negative for fishing companies at the short to medium term, as seen from a purely financial (company) perspective.

Next, we require financial market data about fisheries. To this extent, we rely on Thomson Reuters Datastream, which manages an international database of all listed companies and financial markets. Given that we want to assess financial investors' perception, we investigate all listed fisheries. This results in a sample of 42 companies (see Appendix D, which has data relating to year 2016). We also use the stock market index returns of the countries in which they are situated (Campbell, Cowan, & Salotti, 2010). Our sample includes the listed "keystone actors" (Österblom et al., 2015). These keystone actors dominate all segments of seafood production, operate through an extensive global network of subsidiaries, and are profoundly involved in fisheries and aquaculture decision making. Of the keystone actors, only EWOS and Skretting are unlisted. Thus, although our sample is not representative for all fisheries, it includes the largest companies within the industry as well as most keystone actors, which are regarding as leading the industry (Österblom et al., 2015). Of course, this implies that we cannot generalize the results. However, we focus on all companies in the industry with a quotation on the stock market and as such are able to assess how investors appreciate their value in case these companies face disaster and policy shocks.

The total return index is the most appropriate measure of performance of a firm, because it assumes that all dividend distributions are reinvested in a stock, in addition to tracking that stock's price movements (Brown & Warner, 1985). The calculation of the total return index is based on the price series of the stocks and the dividends paid by the companies to their shareholders. It corrects for any stock splits that might have occurred.[1] As a proxy for countries' market returns, we used total return indices of the main stock exchange of each country (Campbell et al., 2010). These market returns reflect the overall economic conditions and expectations in the markets where the listed firms are situated. We estimate expected returns in relation to the risk of the market and the firm. Appendix D reports the firm-specific data; market information is from Thomson Reuters Datastream, a proprietary database.

Our methodology is rooted in modern finance theory, which assumes that stock prices reflect the discounted sum of all expected future cash flows, indicating that only unexpected information can influence firm value (Fama, 1970). The information about issues that might affect the value of the firm will affect stock prices and returns. This can precede the actual occurrence of the event. For example, the announcement, or even rumor, of a merger of companies already triggers a response from investors, whereas the actual operation usually does not (Brown & Warner, 1985). The framework we use (the market- and risk-adjusted returns model) assumes that the equilibrium outcome of the financial market participants does include all available information at the point in time that the (pricing) decision is made and that they do not systematically err. We acknowledge that on hindsight market pricing is not always efficient; the methodology focuses on the short-term impact of the news (i.e., event). To assess longer term effects of the disasters and policy announcements, structural modeling is the preferred approach, and the event study methodology is not suitable. This requires a theoretical framework next to sufficient data about the variables of interest and the covariates. At this stage, both seem to go missing. Therefore, we concentrate on the short-term effects of news about disasters and policy on listed fisheries.

In line with the literature, we differentiate between the estimation window and the event window (MacKinlay, 1997). The former is used to estimate the expected (normal) returns. In the event window the shocks occur on the event day (Day 0). We relate the actual returns to the expected returns, the difference being the abnormal returns (ARs). Formally, the AR of firm i on day t is

$$AR_{it} = R_{it} - E(R_{it}),$$

where

$$E(R_{it}) = \alpha_i + \beta_i R_{mt} + \varepsilon_{it},$$

$$E(\varepsilon_{it}) = 0.$$

Here, the alpha relates to firm-specific risk and the beta to the sensitivity of the stock to the market. R_{mt} is the return on the stock market on day t (stock markets are closed on weekends and holidays, so days relate to trading days), that is, the benchmark that reflects overall stock market performance and conditions. We estimate expected returns with the help of the market model. This model relates firms' stock returns to the return of the stock market portfolio. The overall economic situation is assumed to be reflected in the R_{mt} in this model (Brown & Warner, 1985). Under general conditions, ordinary least squares regression is an appropriate method to estimate the intersection and slope parameters of firms' stock returns (MacKinlay, 1997). The market model parameters are based on firm and market returns in the estimation window (Brown & Warner, 1985). Because the average of firms' actual returns in the estimation window is equal to their expected returns, average ARs (AARs) in the estimation window are equal to 0. This implies that the objective of this event study is to test whether ARs in the event window are significantly different from 0.

To arrive at the results, we first need to calculate the AAR. This AAR, for n firms on day t, is calculated as

[1]For example, a two-for-one stock split takes an existing share and splits it into two, adjusting the price by half. Similarly, a five-for-one stock split takes one share and splits it into five new shares. The price for this split is adjusted—or divided—by five.

$$AAR_t = \frac{1}{n}\sum_{i=1}^{n} AR_{it}.$$

Furthermore, the cumulative AR (CAR) of firm i over the event window from day D_1 to D_d is

$$CAR_{i,(D_1,D_d)} = \sum_{t=D_1}^{D_d} AR_{it},$$

whereas the cumulative AAR (CAAR) for n firms over the event window is

$$CAAR_{(D_1,D_d)} = \frac{1}{n}\sum_{i=1}^{n} CAR_{i,(D_1,D_d)}.$$

To assess the impact of disasters and policy announcements on firms' stock returns, we test the ARs during the event window for their statistical significance in the event window. In particular, we want to find out whether they significantly differ from 0 (see Campbell et al., 2010). For disasters, it is most of the times clear what the event date is. With announcements, there can be some confusion about when interested parties know about the new policy. In order to allow for a comparison of influence of disasters and polices, the event windows have to be identical. Therefore, we opt for a 7-day event window: from day $t = -3$ to $t = 3$, with $t = 0$ being the event day. This window allows all market participants to process the news regarding the event and to gauge how news affects the value of the firm. Of course, we are particularly interested in the market response on the event day and the days close after. The estimation window consists of 120 days from day $t = -123$ to $t = -4$ and represents the period prior to the event window. This allows for the appropriate estimation of expected or normal stock market returns in the subsequent event window (Brown & Warner, 1980, 1985; MacKinlay, 1997). Thus, in total, we investigate the stock market for 127 trading days with each event.

Table 1 gives an overview of the descriptive statistics of the alphas, betas, and AARs regarding all firms affected, in the estimation and event window. This is for the sample as a whole, as well as for the subsamples of disasters and policy announcements. The alphas are not significantly different from 0, and the betas reveal the fishing companies are quite insensitive to the market in general. As expected, the mean AAR in the estimation window is equal to (approximately) 0. In contrast, the mean AAR in the event window is not equal to

TABLE 1 Descriptive statistics for the average abnormal returns

	Alpha	Beta	AAR (estimation window)	AAR (event window)
All (262 obs)				
Mean	0.0005	0.4209	0.0000	−0.0019
Median	0.0004	0.3290	0.0000	−0.0001
Maximum	0.0052	1.8001	0.0000	0.0403
Minimum	−0.0092	−0.3946	0.0000	−0.0731
Standard deviation	0.0018	0.4419	0.0000	0.0114
Skewness	−1.1936	0.8743	0.1788	−2.0380
Kurtosis	8.0877	3.1046	6.5446	13.811
Disasters (182 obs)				
Mean	0.0004	0.4296	0.0000	−0.0028
Median	0.0004	0.3263	0.0000	−0.0002
Maximum	0.0052	1.8001	0.0000	0.0403
Minimum	−0.0092	−0.3947	0.0000	−0.0731
Standard deviation	0.0017	0.4657	0.0000	0.0131
Skewness	−1.0993	0.9315	0.3455	−1.8017
Kurtosis	8.4988	3.1880	6.3943	10.900
Policy (80 obs)				
Mean	0.0008	0.4013	0.0000	0.0000
Median	0.0007	0.3682	0.0000	0.0000
Maximum	0.0041	1.2102	0.0000	0.0194
Minimum	−0.0071	−0.0826	0.0000	−0.0180
Standard deviation	0.0018	0.3845	0.0000	0.0056
Skewness	−1.4607	0.5264	−0.6878	0.4557
Kurtosis	7.7908	1.9673	5.4523	5.2481

0, foreboding that the AARs is not affected by the events (Brown & Warner, 1980, 1985. Whether this indeed the case has to be decided based on formal tests. We do so by using both parametric and nonparametric tests (Campbell et al., 2010).

3 | RESULTS

Table 2 reports the AARs and the CAARs in the event window and the accompanying test results relating to the two types of events (disasters and policy shocks). As the AARs in the case of disasters are much larger in absolute terms than with policy shocks, these results reveal that there is a much more pronounced market response to disasters than to policy announcements. The null hypothesis is that AARs are equal to 0. We can reject this hypothesis: Table 2 shows that for firms affected by disasters, the AARs on Days 0, 1, 2, and 3 are significantly different from 0. Hence, the results suggest that disasters have a significant impact on firms' AARs. This contrasts with the results for the policy shocks, which turn out to be insignificant. Table 2 also shows the test results of the CAAR of firms in the event window. These suggest that firms affected by disasters had CAARs significantly below 0, indicating disasters negatively affected firms' stock returns. However, the CAARs of policy announcements are insignificant. This might be because we study very different types of policy. In the next section, we will further detail this to find out if this matters indeed. We also establish that the difference between the response to policy shocks and disasters is significantly different from each other on Days 1 and 2 in the event window, namely, about 1% (at the 5% significance level). The comparison of the CAARs shows that the response to disasters is significantly more negative than that to policy shocks. The differential is about 2% (at a 5% level of significance). We conclude that financial investors in fisheries do significantly and negatively respond to disasters but not to policy announcements.

We now go into more detail regarding subsets of events and firms. In particular, we discuss the type of disaster (earthquakes and spills), the type of policy (positive and negative polices), and whether the firm is substantially involved in aquaculture. In addition, we briefly reflect upon timing of the events, firm size, and geography. Table 3 provides a general overview of the findings from our research. The main underlying results are in Appendix E.

3.1 | Earthquakes and spills

We first differentiate investors' response to earthquakes and spills (Table E1). It appears that markets respond in a marginally significant negative way to spills on the event day only. However, they respond much stronger to earthquakes. This is especially evident when analyzing the CAARs. When we explicitly test for differences between the response to earthquakes and spills, we find that these are highly significant. This suggests that investors in fishing companies respond much stronger to news about earthquakes than to those about spills: earthquakes significantly and substantially reduce the market value of fishing companies; spills do only marginally do so. This might relate to the severity of the events: earthquakes are more impactful than spills. Earthquakes may for example result in landslides and tsunamis. Landslides can cause smothering, that is, covering of fish and plants by thick substances that smother them and block sunlight. Landslides may also result in pollution and eutrophication. Tsunamis can severely

TABLE 2 Comparing policies and disasters ([Cumulative] average abnormal returns [percentages] and test statistics [probability values] of parametric and nonparametric tests)

	Policies			Disasters			Difference: disaster policies		
Day	AAR	Parametric test *p* value	Nonparametric test *p* value	AAR	Parametric test *p* value	Nonparametric test *p* value	AAR	Parametric test *p* value	Nonparametric test *p* value
−3	0.0016	0.4747	0.6487	−0.0010	0.4790	0.0852	−0.0026	0.3224	0.1603
−2	0.0009	0.5967	0.5043	0.0004	0.7589	0.8699	−0.0004	0.8431	0.4736
−1	−0.0022	0.2312	0.2791	0.0020	0.2716	0.2986	0.0042	0.1658	0.1587
0	−0.0008	0.6355	0.9712	−0.0039	0.0499	0.0179	−0.0031	0.3411	0.2017
1	−0.0008	0.6551	0.4029	−0.0109	0.0002	0.0015	−0.0101	0.0282	0.1587
2	0.0000	0.9957	0.9443	−0.0113	0.0020	0.0755	−0.0113	0.0434	0.3129
3	0.0016	0.4582	0.8603	0.0055	0.0385	0.5102	0.0039	0.3583	0.6204
Period	CAAR	Parametric test *p* value	Nonparametric test *p* value	CAAR	Parametric test p-value	Nonparametric test *p* value	CAAR	Parametric test *p* value	Nonparametric test *p* value
[0, 3]	−0.0001	0.9777	0.9136	−0.0207	0.0002	0.0010	−0.0206	0.0167	0.0663
[1, 3]	0.0007	0.8288	0.7965	−0.0167	0.0006	0.0028	−0.0175	0.0221	0.1213

For all parametric tests, we have a Student *t* test; for the nonparametric tests, we use the Wilcoxon sign test for one sample tests and the Wilcoxon rank sum test in the case of two samples tests. The test results are transformed in probability values, accounting for the degrees of freedom.
Abbreviations: AAR, average abnormal return; CAR, cumulative abnormal return.

TABLE 3 Overview of the results

Analysis	Significant difference?	Qualification	Results are reported in
Disasters versus policy shocks	YES	Markets respond much stronger to disasters than to policy shocks.	Table 2
Spills versus earthquakes	YES	Markets respond stronger to earthquakes; they respond to both types of events, but only marginally so to spills.	Table E1
Positive versus negative policy shocks	YES	Marginally so. Markets respond stronger to negative than to positive policy shocks.	Table E2
Firms high versus firms low in aquaculture	NO	No significant differences in the response to disaster and policy shocks.	Table E3
Disasters with firms high versus firms low in aquaculture	YES	Marginally so. Firms low in aquaculture respond significant to spills; those high do not so, but they respond stronger to earthquakes.	Table E4
Positive and negative policy shocks with firms high versus firms low in aquaculture	YES	Marginally so. Firms low in aquaculture respond to positive policy shocks on Day 1. Firms high seem insensitive.	Table E5
Recent versus old events	YES	Marginally so. Markets did respond slightly more pronounced to old events. Based on very small subsample.	Not available upon request.
Large versus small firms	NO	Based on very small subsample.	Not available upon request.
European versus Asian firms	NO	Based on very small subsample.	Not available upon request.
Japanese versus Chinese firms	NO	Based on very small subsample.	Not available upon request.

harm fish and marine ecosystems. Spills usually are local. With our sample of large, internationally operating firms, the effect of fishing companies' activities in a specific location only have a small influence on overall operations.

3.2 | Negative and positive policy

We also differentiate between negative and positive policies, as it might be that the nonsignificance of the market response to policy shocks (see Table 2) results from the effect of the two cancelling each other out. To this extent, we divide the policy announcements in two groups: positive and negative announcements, where we base the decision about whether an announcement is positive or negative on their direct impact on firm profitability. Thus, for example, a policy that aims at improving the sustainability of fisheries in a particular area by limiting current fishing rights is qualified as a negative policy. As such, we qualify 22 policies as positive and 19 as negative (Appendix C). We investigate how investors in fisheries companies respond to negative and positive policy announcements and test whether any differential in their response is significant from a statistical point of view (see Table E2). We find that markets respond in a marginally significant and positive way to positive policies on the first day after the policy announcement. With the CAARs [1; 3], we detect a marginally significant response to negative policies. The differential between positive and negative shocks is only significant on day one in the event window with AARs and for [1; 3] with CAARs. Therefore, it appears that the differentiation between positive and negative policies does only slightly help explain the nonsignificant results for policy shocks in Table 2. In several cases, the signs of the ARs with positive and negative policies have opposite signs. However, the difference is not always significant. There are insufficient cases to specify if and how other policy characteristics might play a role.

3.3 | Aquaculture

Given the advance of aquaculture (FAO, 2016), we wonder if there is a difference in the appreciation of investors to shocks regarding firms that are high or low in aquaculture. To this extent, we split the sample firms in two groups. The split results from the mean fraction of aquaculture in total turnover. As such, fisheries are either qualified as HI, when they have above average fraction of aquaculture, or LO, when they have below average fraction of aquaculture business in their turnover (see Appendix D). We first investigate how the two groups respond to all events in general and then zoom in on event characteristics. Thus, first, we differentiate between the responses of investors in firm either high or low in aquaculture to policy shocks and disasters (Table E3). It appears that being high or low in aquaculture is not a distinguishing feature, as we do not observe any statistical significance. Next, we differentiate along event characteristics. The comparison as to how firms high or low in aquaculture respond to spills and

earthquakes is in Table E4. Firms low in aquaculture respond slightly more to spills than firms high in aquaculture do. For earthquakes, it is the other way round. We also compare the sensitivity of stocks of the two types in relation to negative and positive policy shocks (Table E5). Here, we arrive at the same results as in the main analysis. An exception is the differential in the response to the two policy types with firms low in aquaculture, which shows a significant difference in the response on Days 0 and 1.

In addition to these results, we discuss our findings for some other attributes of the events, which are not reported for the sake of brevity. First, we compare "old" events with "recent" ones. To this extent, we divide all events in three equally sized groups and compare the response to events in the first (oldest: until 2006) and third (most recent: from 2013 onwards). Thus, we leave out one third of the observations. We observe a (marginally) significant difference between group one and three: The response to the oldest events is slightly stronger than to ones that are more recent. This might suggest that investors already price (discount) the influence of shocks.

Next, we investigate the responses of investors to events regarding firm size. Here, we compare the responses of the 15 largest firms with those of the 15 smallest firms (and leave out the 12 firms that are in between in order to have a clear distinction between small and large). Here, we do not detect a significant difference in the ARs of the two groups. We want to point out that this should not be a surprise as in fact all firms with a listing on a stock exchange already are relatively large firms.

We also compare the response of investors to events with European firms with those with Asian firms, and we compare Japanese and Chinese firms. In both cases, we do not arrive at significant differences in the response of financial markets to news about these subgroups.

We conclude that disasters, and earthquakes in particular, have a statistically significant effect on fishing companies' stock returns. We detect a marginal difference in the response to positive vis-à-vis negative policy announcements. This means that investors assume that these events influence the profitability and therefore value and business viability of fishing companies. Firm attributes do not seem to matter much from the investor perspective. We do find, however, that firms low in aquaculture show a slightly more pronounced response to (negative) policies, whereas firms high in aquaculture seem to respond somewhat stronger to earthquakes than to spills. As such, our study provides quantitative evidence for the assertion that disasters should be taken into consideration when it comes to assessing the sensitivity of fisheries and aquaculture. From the perspective of financial market participants, fisheries are deemed to be quite resilient to policy announcements but not to disasters.

4 | CONCLUSION

Shareholders are interested in the influence of shocks on the value of their stocks. The aim of our study was to examine the effect of disasters and policy announcements on fishing companies' stock market returns. To do so, we investigated how investors appreciate the effect of such events on firm value. This perspective is highly relevant for companies that seek to expand their business, as they require financial markets for financing such expansion. Investing is an important instrument for leverage of companies (see Galaz et al., 2018); financial investors value companies, and we studied how disasters and announcements influence how they valuate firms. As such, we focused on the sensitivity of shareholders in large companies that play a dominant role in global fisheries and have a disproportionate impact on the sustainability of marine resources (Blasiak et al., 2018; Jouffray et al., 2019; Österblom et al., 2015) to shocks.

Using a sample of 87 events (shocks) that potentially affect 42 internationally listed fishing companies, we performed an event study to detect the effects of disasters and policy announcements on their stock market returns. We investigated whether the companies' returns did react in a significant manner to these events and whether particular attributes of events and/or firms did matter in this respect. Especially earthquakes had a very pronounced impact on firms' stock returns. However, that spills and the differential between negative and positive policy announcements did only have a marginal influence. Markets responded significantly differently to disasters than they do to announcements. In most other instances, we found that financial market investors do not seem to differentiate much between the impact of various shocks on firms with different characteristics such as size, location, and business type (high or low in aquaculture). Therefore, we may conclude that financial investors differentiate between the origins of shocks but do not seem to assume that firm characteristics matter much regarding listed firms' sensitivity to shocks. This allows for leveraging in relation to social and environmental change in the industry (see Galaz et al., 2018). As such, we feel that we contributed to the knowledge about human (business) and policy dimensions of global environmental change from a finance perspective. It showed that finance theory and practice also can help inform about consequences of (responses to) global environmental change (see also Lindegren & Brander, 2018).

Our approach and findings complement the ecosystem perspective regarding the impact of shocks on fisheries (Smith et al., 2017; Ward et al., 2018). The investor perspective we pursued especially informs the financial market appreciation of the resilience of listed fisheries to external shocks. Exactly these companies are the keystone actors that drive or hamper change in the industry (Blasiak et al., 2018; Österblom et al., 2015).

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

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APPENDIX A.

TABLE A1 List of events

Event number	Date (MM-DD-YYYY)	Category (disaster, policy)	Country/territory affected
1	10-1-1989	Disaster	USA
2	10-18-1991	Disaster	USA
3	6-29-1992	Disaster	USA
4	4-25-1993	Disaster	USA
5	6-28-1993	Disaster	USA
6	1-17-1995	Disaster	USA
7	8-8-1995	Disaster	USA
8	7-11-1996	Disaster	China
9	10-23-1997	Disaster	China
10	2-3-1998	Disaster	China
11	1-10-1999	Disaster	China
12	11-1-1999	Disaster	China
13	11-19-1999	Disaster	China
14	1-14-2000	Disaster	China
15	8-21-2000	Disaster	China
16	9-3-2000	Disaster	USA
17	2-28-2001	Disaster	USA
18	5-23-2001	Disaster	China
19	11-3-2002	Disaster	USA
20	5-26-2003	Disaster	Japan
21	7-21-2003	Disaster	China
22	7-25-2003	Disaster	Japan
23	9-25-2003	Disaster	Japan
24	10-25-2003	Disaster	China
25	12-22-2003	Disaster	USA
26	3-24-2004	Disaster	China
27	10-23-2004	Disaster	Japan
28	10-15-2006	Disaster	USA
29	6-2-2007	Disaster	China
30	7-16-2007	Disaster	Japan
31	5-12-2008	Disaster	China
32	4-6-2009	Disaster	Italy
33	10-20-2009	Policy	USA, Mexico
34	2-8-2010	Policy	USA
35	2-27-2010	Disaster	Chile
36	4-10-2010	Policy	USA
37	4-13-2010	Disaster	China
38	9-3-2010	Disaster	New Zealand
39	2-21-2011	Disaster	New Zealand
40	3-11-2011	Disaster	Japan
41	4-2-2011	Policy	USA
42	5-21-2011	Policy	EU
43	6-13-2011	Disaster	New Zealand
44	1-1-2012	Policy	USA

(Continues)

TABLE A1 (Continued)

Event number	Date (MM-DD-YYYY)	Category (disaster, policy)	Country/territory affected
45	1-11-2012	Policy	USA, Colombia, Ecuador, Ghana, Italy, Mexico, Panama, South-Korea, Spain, Tanzania, Venezuela
46	1-18-2012	Policy	Norway
47	5-17-2012	Policy	Denmark
48	5-29-2012	Disaster	Italy
49	5-31-2012	Policy	USA, EU
50	6-29-2012	Disaster	China
51	7-5-2012	Policy	USA, Mexico
52	7-11-2012	Policy	Japan, EU
53	8-1-2012	Policy	Denmark, Germany, Ireland, Spain, France, Lithuania, Netherlands, Poland, Portugal, UK
54	8-23-2012	Policy	USA
55	9-7-2012	Disaster	China
56	9-13-2012	Policy	USA
57	10-9-2012	Policy	EU
58	10-24-2012	Policy	EU
59	1-28-2013	Policy	USA
60	2-20-2013	Policy	USA
61	3-12-2013	Policy	Norway
62	3-14-2013	Policy	Denmark
63	4-18-2013	Disaster	USA
64	5-14-2013	Policy	EU
65	5-27-2013	Policy	EU
66	7-10-2013	Policy	USA
67	7-17-2013	Policy	EU
68	7-21-2013	Disaster	China
69	8-8-2013	Policy	EU
70	8-20-2013	Policy	Denmark
71	8-23-2013	Policy	USA
72	10-25-2013	Policy	Norway, Sweden, Denmark
73	10-30-2013	Policy	EU
74	2-13-2014	Policy	USA
75	3-23-2014	Policy	Denmark
76	4-21-2014	Policy	Thailand
77	6-11-2014	Policy	Denmark
78	6-27-2014	Policy	USA
79	8-7-2014	Policy	EU
80	8-18-2014	Policy	Denmark
81	8-24-2014	Disaster	USA
82	10-28-2014	Policy	EU
83	12-1-2014	Policy	USA, Mexico
84	12-4-2014	Policy	Norway
85	12-17-2014	Policy	EU
86	9-16-2015	Disaster	Chile
87	4-15-2016	Disaster	Japan

APPENDIX B.

TABLE B1 Characteristics of disaster events

#	Date (DD-MM-YYYY)	Country or Territory affected	Type	Estimated size of damage[a]
1	1-10-1989	USA	Spill	358,000
2	18-10-1991	USA	Spill	5,600,000
3	28-6-1992	USA	Spill	33,500
4	25-4-1993	USA	Spill	75,000
5	28-6-1993	USA	Spill	92,000
6	17-1-1995	USA	Spill	40,000,000
7	8-8-1995	USA	Spill	250,000
8	11-7-1996	China	Spill	36,100
9	23-10-1997	China	Spill	80,000
10	3-2-1998	China	Earthquake	506,000
11	10-1-1999	China	Earthquake	285,500
12	1-11-1999	China	Spill	44,000
13	19-11-1999	China	Spill	70,000
14	14-1-2000	China	Spill	73,500
15	21-8-2000	China	Spill	43,000
16	2-9-2000	USA	Spill	50,000
17	28-2-2001	USA	Earthquake	2,000,000
18	23-5-2001	China	Spill	36,000
19	3-11-2002	USA	Spill	56,000
20	26-5-2003	Japan	Spill	233,000
21	21-7-2003	China	Spill	75,000
22	25-7-2003	Japan	Spill	411,000
23	25-9-2003	Japan	Spill	90,000
24	25-10-2003	China	Spill	40,000
25	22-12-2003	USA	Spill	300,000
26	24-3-2004	China	Spill	74,000
27	23-10-2004	Japan	Earthquake	28,000,000
28	15-10-2006	USA	Spill	73,000
29	2-6-2007	China	Spill	310,000
30	16-7-2007	Japan	Earthquake	12,500,000
31	12-5-2008	China	Earthquake	86,000,000
32	6-4-2009	Italy	Earthquake	2,500,000
33	27-2-2010	Chile	Earthquake	30,000,000
34	13-4-2010	China	Spill	500,000
35	3-9-2010	New Zealand	Earthquake	6,500,000
36	21-2-2011	New Zealand	Earthquake	15,000,000
37	11-3-2011	Japan	Earthquake	220,085,456
38	13-6-2012	New Zealand	Earthquake	3,000,000
39	29-5-2012	Italy	Earthquake	15,800,000
40	29-6-2012	China	Spill	68,000
41	7-9-2012	China	Spill	1,000,000
42	18-4-2013	USA	Spill	100,000
43	21-7-2013	China	Earthquake	5,249,476
44	24-8-2014	USA	Spill	700,000

(Continues)

TABLE B1 (Continued)

#	Date (DD-MM-YYYY)	Country or Territory affected	Type	Estimated size of damage[a]
45	16-9-2015	Chile	Earthquake	600,000
46	15-4-2016	Japan	Earthquake	4,600,000

[a]Damage in terms of thousand US dollars.
Sources: International Tanker Owners Pollution and UNEP Accidental Oil Discharges.

APPENDIX C.

TABLE C1 Characteristics of policy events

#	Date (DD-MM-YYYY)	Country/Territory affected	Description	Negative	Positive
1	20-10-2009	USA, Mexico	Gulf of Mexico Individual Fishing Quota (IFQ) Program Announcements	1	0
2	8-2-2010	USA	Recovery plan for certain marine species and protection programs to marine mammal	1	0
3	10-4-2010	USA	New restrictions on taking Fish	1	0
4	2-4-2011	USA	NOAA designed critical habitat for Cook Intel Beluga whale	1	0
5	21-5-2011	EU	A decision has been taken to close the fishery for mackerel	1	0
6	1-1-2012	USA	United States tightens fishing policy, setting 2012 catch limits for all managed species.	1	0
7	11-1-2012	Colombia, Ecuador, Ghana, Italy, Mexico, Panama, South-Korea, Spain, Tanzania, USA, Venezuela	IUU fishing regulation	0	1
8	18-1-2012	Norway	Norway's agreements with the European Union	1	0
9	17-5-2012	Denmark	The Danish government changes from a quota allocation based on landings to a system based on catches.	0	1
10	31-5-2012	USA, EU	Cooperation against illegal fishing worldwide	0	1
11	5-7-2012	USA, Mexico	Red snapper quota fishing	1	0
12	11-7-2012	Japan, EU	European Union and Japan join forces against illegal fishing.	0	1
13	1-8-2012	Denmark, Germany, Ireland, France, Lithuania, Netherlands, Poland, Portugal, Spain, UK	The European Commission announced today deductions from 2012 fishing quotas of those Member States that had exceeded their quotas in 2011.	1	0
14	23-8-2012	USA	Support to fishing industry	0	1
15	13-9-2012	USA	(NOAA) explore all possible options to mitigate these impacts.	0	1
16	9-10-2012	EU	Expansion of fishing opportunities for EU vessels for certain deep-sea fish stocks	0	1
17	24-10-2012	EU	A new Fund installed to help deliver the objectives of the reform of the Common Fisheries Policy to help fishermen in the transition towards sustainable fishing, as well as coastal communities in the diversification of their economies.	0	1

TABLE C1 (Continued)

#	Date (DD-MM-YYYY)	Country/Territory affected	Description	Negative	Positive
18	28-1-2013	USA	NOAA improves internal fisheries management.	0	1
19	20-2-2013	USA	NOAA catch share programs	1	0
20	12-3-2013	Norway	A Unit Quota System (UQS) introduced to enable the owners of deep-sea trawlers, deep-sea purse seiners, and deep-sea long liners to transfer quotas form scrapped vessels to one remaining vessel.	0	1
21	14-3-2013	Denmark	The Fisheries Minister announced the unilateral setting of a catch limit of 105,230 tons.	1	0
22	14-5-2013	EU	EU ministers agreed on a reform of the EU's fishing quota system that is set on curbing overfishing.	1	0
23	27-5-2013	EU	Recovery plan for Bluefin tuna	1	0
24	10-7-2013	USA	Government shutdown cuts off fishing areas safe label on tuna products.	0	1
25	17-7-2013	EU	An updated list of vessels that cannot land or sell their fish in the EU as they have been identified as taking part in (IUU)	0	1
26	8-8-2013	EU	The European Commission has today announced deductions from 2013 fishing quotas for those Member States that declared having exceeded their quotas in 2012.	1	0
27	20-8-2013	Denmark	Protection of Atlantic herring	1	0
28	23-8-2013	USA	NOAA deep-sea program for Coral protection	1	0
29	25-10-2013	Denmark, Norway, Sweden	The completion of negotiations on a new agreement between the European Union and Norway on reciprocal access to fishing in the waters of the Skagerrak	0	1
30	30-10-2013	EU	Expanded fishing opportunities for groups of fish stocks, applicable in EU waters and, for EU vessels, in certain non-EU waters	0	1
31	13-2-2014	USA	NOAA created a policy to better serve American recreational saltwater anglers and the community that rely on them.	1	0
32	23-3-2014	Denmark	The Faroe fleet fishing days is cut by 10%.	1	0
33	21-4-2014	Thailand	Thai Union, one of the world's largest seafood producers, has committed itself in 2014 to refrain from purchasing seafood from vessels involved in transshipments in Thailand's EEZ.	0	1
34	11-6-2014	Denmark	The Faroe Islands will discontinue unsustainable fisheries in exchange for a lift of the EU trade restrictions.	0	1
35	27-6-2014	USA	NOAA announced a new policy to clarify the decision to list species as threatened or endangered.	1	0
36	7-8-2014	EU	EU Commission moves to ban driftnet fishing meets resistance; Russia ban.	1	0

(Continues)

TABLE C1 (Continued)

#	Date (DD-MM-YYYY)	Country/Territory affected	Description	Negative	Positive
37	18-8-2014	Denmark	EC repeals measures adopted against the Faroe Islands in August 2013 following their unsustainable fishery on Atlanto-Scandinavian herring.	0	1
38	28-10-2014	EU	Expanded fishing opportunities for groups of fish stocks, applicable in EU waters and, for EU vessels, in certain non-EU waters	0	1
39	1-12-2014	USA, Mexico	The Gulf of Mexico Fishery Management Council reminds recreational fishermen the gag season closes.	1	0
40	4-12-2014	Norway	EU and Norway agree on management of shared North Sea fish stocks for 2015.	0	1
41	17-12-2014	EU	EU green-lights fishing quotas.	1	0

APPENDIX D.

TABLE D1 Characteristics of firms used in the event study

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
1	Aquachile	Empresas Aquachile SA is a Chile-based company primarily engaged in the aquaculture sector. The Company's activities are divided into three business segments: Salmon and trout, Tilapia, and Food. The Salmon and trout division focuses on the cultivation, processing, and distribution of the Atlantic and coho salmon, as well as sea trout. The Tilapia division is responsible for the farming of tilapia. The Food division includes production of fish feed. The company holds marine, river, and lake aquaculture concessions on the Chilean and Costa Rican coast. It exports products to the America, Europe, and Asia. The company operates through a number of subsidiaries, such as Aguas Claras SA, AquaChile Inc, Grupo ACI SA, Inversiones Salmones Australes Ltda, Salmones Maullin SA, Antarfood SA, and Alitec Pargua SA.	HI	99	993	Chile/America	https://www.marketscreener.com/EMPRESAS-AQUACHILE-S-A-10202833/company/
2	Austevoll Seafood	Austevoll Seafood ASA (AUSS) is a Norway-based company engaged in the ownership and operation of fishing vessels, fishmeal plants, canning plants, freezing plants, salmon farming, and marketing. The company's activities are structured into four business segments: production of fishmeal and fish oil, which is engaged in the manufacture of fishmeal and oil; products for consumption, which include canned horse mackerel, mackerel, sardines, tuna, and salmon, in addition to processed horse mackerel for freezing and distribution of fresh fish; Pelagic North Atlantic; and production, sale, and distribution of salmon, trout, and other seafood. The company operates through its subsidiaries, including Austevoll Eiendom AS, Auss Shared Service AS, Leroy Seafood Group ASA. A-Fish AS, Inv. Pacfish Ltd, Laco IV AS, Aumur AS, and Austevoll Laksepakkeri AS. In August 2013, Austevoll Seafood ASA completed the purchase of 50% interest in Welcon Invest AS (Welcon).	HI	88	1,593	Norway/Europe	https://www.marketscreener.com/AUSTEVOLL-SEAFOOD-ASA-1413089/?type_recherche=rapide&mots=auste
3	Bakkafrost	Bakkafrost specializes in salmon farming. Net sales breakdown by activity as follows: • salmon farming (65.2%).	HI	65	3,634	Denmark/Europe	https://www.marketscreener.com/BAKKAFROST-6103708/company/

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		• manufacturing of fish feed, fishmeal and fish oil (21.4%). • salmon-based product manufacturing (13.4%).At the end of 2019, the group operated 21 production sites located in Norway. Net sales are distributed geographically as follows: Europe (63.7%), China (19%), and the United States (17.3%).					
4	Blumar	Blumar SA is a Chile-based company engaged in the fishing and food processing sectors. The companies' main facilities include fishmeal and fish oil production plants, freezing and breaded plants, fish unloading warehouses, and fattening centers, which are located in the communes of Caldera, Coronel, Corral, and Talcahuano, as well as in the regions of Los Lagos and Aysen. The company is also engaged in the farming and processing of salmon, mussels, jack mackerels, and mackerels. Its products are exported to South and North America, Europe, Asia, and Africa. As of December 31, 2011, the company owned such subsidiaries as Pesquera Bahia Caldera SA, Salmones Blumar SA, Golfo Comercial SA, Pesquera Araucania Dos SA and Granja Marina SA, and Grupo Las Urbinas was its major shareholder with 45.31% of its interest.	HI	54	333	Chile/America	https://www.marketscreener.com/BLUMAR-S-A-20699345/company/
5	CERmaq Group	Cermaq ASA is a Norway-based company active in the aquaculture industry. It is engaged in the farming of salmon and trout. The company, along with its subsidiaries, operates in one business segment, namely, aquaculture, which consists of two divisions: fish feed production, which involves the production and sale of fish feed, and fish farming, which involves the breeding and on-growing, as well as the slaughtering, processing, sale, and distribution of salmon and trout. The companies' other activities consist of operations carried out through its subsidiary, Norgrain AS, the associated company, Denofa AS, and the parent company. The company operates through its subsidiaries, including Statkorn Aqua AS and Mainstream Norway AS, among others. Its main shareholder is MC Ocean Holdings Limited.	HI	95	-	Norway/Europe	https://www.marketscreener.com/CERMAQ-GROUP-AS-1413107/company/
6	Charoen Pokphand Foods	Charoen Pokphand Foods Public Company Limited is a Thailand-based company engaged in the operation of agro-industrial and integrated food businesses. The businesses are divided into two segments: the livestock	LO	14	7,834	Thailand/Asia	https://www.marketscreener.com/CHAROEN-POKPHAND-FOODS-10859580/company/

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		business segment, which comprises chicken, duck and pigs, and the aquaculture business segment, which consists of shrimp and fish. The integrated businesses incorporate the manufacture of animal feed, animal breeding, and animal farming; meat processing, the manufacture of semicooked meat and fully cooked meat; food products and ready meal products, as well as the meat and food retailer and restaurant businesses. The products are distributed and exported under the brand name CP in Asia, Europe, and America. Other products include grilled and fried chicken under the brand name 5-Star, and sausages, chicken rolls, chicken nuggets, hamburgers, and hotdogs.					
7	Chuo Gyorui	Chuo Gyorui Co., Ltd. is a company mainly engaged in the wholesale of marine and processed marine products. The company operates in four business segments. The marine products wholesale segment is engaged in the sale of marine products and processed products. The refrigerated warehouse segment is engaged in the refrigerated storage of marine products. The real estate leasing segment is engaged in the leasing of real estate and land. The cargo handling segment is engaged in the cargo handling of marine products.	LO	3	98	Japan/Asia	https://www.marketscreener.com/CHUO-GYORUI-CO-LTD-6494017/company/
8	Daisui	DAISUI CO., LTD. is mainly engaged in the wholesale of marine products. The company operates in two business segments. The marine product sales segment is primarily engaged in the sale of marine products in the central wholesale market according to the wholesale market regulations. The refrigerated warehousing segment is involved in the operation of refrigerated warehouses.	LO	0	29	Japan/Asia	https://www.marketscreener.com/DAISUI-CO-LTD-14056178/company/
9	Dongwon	DONGWON INDUSTRIES CO., LTD. is a Korea-based company engaged in the provision of marine products. The company operates its business through three main divisions: fisheries division, logistics division, and other business division. Its fisheries division catches and distributes tunas and other marine products. Its logistics division is engaged in the provision of processing, transportation, and distribution of marine products. Its other business division engages in the rental business	LO	15	608	Korea/Asia	https://www.marketscreener.com/DONGWON-F-B-CO-LTD-6494948/company/
10	Grieg Seafood	Grieg Seafood is one of the world's largest salmon growers. The group is also developing a salmon processing activity.	HI	92	1,115	Norway/Europe	https://www.marketscreener.com/GRIEG-SEAFOOD-1413163/company/

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		Net sales (including intragroup) breakdown by area of activity as follows: • Finmark (37.1%): 29.8 Kt produced in 2018. • British Columbia (23.9%): 16.6 Kt produced. • Rogaland (21.3%): 16.3 Kt produced. • Shetland (17.7%): 11.9 Kt produced.Net sales are distributed geographically as follows: Europe (67.9%), Asia (14%), the United States (10.6%), Canada (3.4%), and others (4.1%).					
11	Hanwa	HANWA CO., LTD. is a Japan-based company mainly engaged in the sale of steel metal raw materials, nonferrous metals, foods, petroleum, and chemical products, wood, and machinery. The company operates through six business segments. The Steel business is engaged in the provision of steel bars, construction works, steel plates, special steels, wires, steel pipes, and scrap iron. It is also engaged in the metal processing and storage. The Metal Raw Materials business is engaged in the provision of nickel, chromium, silicon, manganese, and ferroalloys. The Overseas Sales Subsidiary business is engaged in the sale of products at major overseas bases. The Petroleum and Chemicals business is engaged in the sale of petroleum products, industrial chemicals, chemicals, and waste fuels. The Food business provides seafood and livestock products. The Nonferrous Metals business supplies aluminum, copper and zinc, and conducts recycling business. It also manages and operates amusement facilities.	LO	0	724	Japan/Asia	https://www.marketscreener.com/HANWA-CO-LTD-6492255/company/
12	Itochu	Itochu Corporation is a diversified group organized around eight areas of activity: • distribution of food products (37% of net sales): frozen food, vegetable oil, sweeteners, sugars, etc. • distribution of hydrocarbons (26.9%): hydrocarbons (natural gas, oil products, bioethanol, etc.).The group also develops manufacturing of chemical products activity. • manufacturing and sale of industrial and construction machines, vehicles, and ships (10.5%). • sale of consumer products (7.7%).The group also develops forest products sale and real estate development activities.	HI	37	31,499	Japan/Asia	https://www.marketscreener.com/ITOCHU-CORPORATION-6491311/company/

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		• distribution of computing and telecommunication equipment (6.3%): data transmission, Internet access, media content broadcasting, and mobile telephony equipment.The group also offers financial services: • production of metals and coal (5.7%). • sale of textile products (5.1%). • others (0.8%).					
13	Kibun Foods	Kibun Foods Inc. is the leader in Japan for production, distribution and sales of surimi seafood products that contribute to a healthy life. As a company that transforms natural resources into quality food products, kibun understands the need to appreciate nature's gift and to operate in harmony with the environment. For this reason, we have obtained ISO99001 and HACCP. Tokyo Factory has obtained ISO14001.	LO	0	NA	Japan/Asia	https://www.fis.com/fis/companies/details.asp?l=e&filterby=species&=&country_id=&page=1&company_id=59402&submenu=categories
14	Kyokuyo	KYOKUYO CO., LTD. is a Japan-based company primarily engaged in food business. The company operates in six business segments. The marine products purchasing business segment is engaged in the purchase, processing, and sale of marine products. The frozen food segment is engaged in the manufacture and sale of frozen food. The normal temperature products segment is engaged in the manufacture and sale of canned processed foodstuffs and seafood delicacy. The logistics service segment operates refrigerated warehouse business. The tuna fishery segment is engaged in catching, firm raising, processing, and sale of sliced bonito and tuna. The other segments are engaged in the insurance agency business.	LO	11	266	Japan/Asia	https://www.marketscreener.com/KYOKUYO-CO-LTD-6494002/company/
15	Marine Harvest	Mowi ASA (formerly Marine Harvest) specializes in breeding, processing, and marketing salmon and trout. Net sales breakdown by activity as follows: • sale of fish farming and preparation of fish (97.7%) salmon, trout, cod, sturgeon, etc.The group also develops production of fish-based products activity (smoked salmon, fish terrines, rillettes, etc.).The activity is carried out primarily in Norway, Scotland, Canada, Chile, Ireland, and the Faeroe Islands. Net sales breakdown by family of products between processed and smoked salmon (51.4%), whole salmon (39.1%), and others (9.5%). Net sales breakdown	HI	98	9,504	Norway/Europe	https://www.marketscreener.com/MOWI-ASA-52035183/company/

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		geographically as follows: Europe (67.5%), America (21.4%), Asia (9.1%), and others (2%)					
16	Marr	Marr SpA is an Italy-based company specialized in the distribution of food products to the nondomestic catering sector. Marr SpA serves mainly restaurants, hotels, pizza restaurants, resorts, and canteens, with an offer that includes various food products, including fish, meat, various foodstuffs, and fruit and vegetables and at the different conservations (frozen, fresh, and dry). The company operates nationwide through a logistical-distribution network composed of around 35 distribution centers, with around five stocking platforms and approximately five cash and carry, around five agents with warehouses, and over 700 trucks. The operational structure is organized with the objective of delivering the products requested every day and within a day of reception of the order.	HI	99	991	Italy/Europe	https://www.marketscreener.com/MARR-S-P-A-160246/company/
17	Marubeni	Marubeni Corporation is a diversified group organized primarily around five business segments: • sale of food products, consumer goods, and consumer electronics (58.5% of sales). In addition, the group develops insurance, financing, and property management activities. • chemical and forest products manufacturing (22.6%): petrochemical and agrochemical products, wood, paper, pulp, cardboard, etc. • production and distribution of oil, gas, and electricity (10.6%). The group also develops a metal and mineral resources production activity. • management and operation of aircraft and ships (5.6%).The group also develops activities in the sale of cars, car leasing, the sale of industrial machinery and equipment, and the sale of construction equipment: • development of energy production units and industrial installations (2.7%).	LO	0	8,091	Japan/Asia	https://www.fis.com/fis/companies/details.asp?l=e&company_id=72169
18	Maruha Nichiro	Maruha Nichiro Corporation is a Japan-based company principally engaged in the fishing, aquaculture, food manufacture, processing, and sale business. The company operates in five business segments. Fishery and aquaculture segment is involved in fishery business, aquaculture business, and the procurement of fishery resources. Trading segment is involved in the procurement and sale of marine	HI	93	1,043	Japan/Asia	https://www.marketscreener.com/MARUHA-NICHIRO-CORPORATIO-15925504/company/

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		products and livestock products. Overseas segment is involved in the sale of marine products and processed foods, as well as the producing and sale of surimi. Processing segment is involved in the manufacture and sale of frozen foods, canned foods, fish sausages, chikuwa, desserts, seasonings, freeze-dried products, and chemical products. Logistics segment stores and transports frozen products. The company is also involved in the feed storage, shipping, real estate business, as well as the manufacture and sale of furs and pet foods.					
19	Maruichi	MARUICHI Co., Ltd. is a Japan-based company mainly engaged in the wholesale of fresh and processed foods such as marine products and livestock products and general processed foods. The company operates through four business segments. The marine products segment sells marine products, processed marine products, daily items, and frozen foods and manufactures processed marine products. The general food segment sells general dry foods, general processed foods, and confectionery. The livestock segment manufactures and sells livestock products and processed livestock products. The Maruizu Nagano Prefectural Water Group develops food wholesale business mainly in the Nagano Prefecture area. The company is also involved in the logistics and refrigerated warehouse business, office automation (OA) equipment and communication equipment sales and insurance agency business.	LO	13	229	Japan/Asia	https://www.marketscreener.com/MARUICHI-CO-LTD-6493721/company/
20	Mitsubishi	Mitsubishi becomes Cermaq's new owner (10/22/2014) The Ministry of Trade, Industry, and Fisheries has accepted the offer made by Mitsubishi Corporation for the Norwegian State's shares in the aquaculture company Cermaq. These shares, included in the voluntary offer made by the Japanese firm through its subsidiary MC Ocean Holdings Limited, represent approximately 90.97% of the outstanding shares and votes in the Norwegian company. The bid for the firm holding extensive aquaculture assets in Norway and Chile amounts to USD 1.4 billion, Reuters reported. Given completion of the offer, the state will no longer hold shares in the company. Mitsubishi informed in a release that the remaining terms and conditions of the offer are set out in the Offer Document	HI	90	29,894	Japan/Asia	https://www.fis.com/fis/techno/newtechno.asp?l=e&id=72211&ndb=1

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		and the Japanese firm will issue a notification through the Oslo Stock Exchange when the conditions for completion of the offer have been met, waived, or failed to be met. In its release, it also stated that if the conditions of the offer are met or waived, Mitsubishi Corporation will, upon completion of the offer, initiate a compulsory acquisition of the remaining shares of the company, it does not own in accordance with applicable laws and to propose that the company applies for a delisting of the shares from the Oslo Stock Exchange. With this operation, Mitsubishi is following Japan's other traders by moving into the food industry amid a slowdown in the pace of Chinese demand for coal and iron ore. Buying Cermaq will form the world's second-largest salmon farmer.					
21	Nichimo	NICHIMO CO., LTD. is engaged in the food, marine, machinery, material, biotics, logistics, and other businesses. The company operates in six segments. The food segment processes and sells frozen fish, fish eggs and fish paste. The ocean segment is engaged in the manufacture and sale of nets, ropes, the repair of fishing equipment, as well as the sale of ship equipment and materials for fishing and sea farming. The machinery segment is engaged in the manufacture and sale of food processing machines. The material segment sells synthetic resin, packaging materials, and agricultural materials. The biotics segment manufactures and sells fermented soybean products, as well as sells health food products. The logistics segment provides logistics and transportation services. Company is also involved in the provision of the sale of petrochemical products, the manpower dispatching business, and real estate business.	HI	80	57	Japan/Asia	https://www.marketscreener.com/NICHIMO-CO-LTD-6491799/company/
22	Nichirei	Nichirei Corporation is a diversified group organized around four sectors of activity: • processing and distribution of food products (66.6% of net sales): frozen foods, tinned foods, beverages, and food ingredients (58.5% of net sales), meat and poultry products (23%), and sea products (18.5%), • logistic services (31.9%): storing, warehousing, transportation, etc. • real estate assets promotion and leasing (0.6%). • others (0.9%): primarily distribution of pharmaceutical products.	HI	67	3,716	Japan/Asia	https://www.marketscreener.com/NICHIREI-CORPORATION-6491163/company/

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
23	Nippon Suisan Kaisha	Nippon Suisan Kaisha, Ltd. is one of the Japanese largest food processing groups. Net sales breakdown as follows: • manufacturing and sale of food products (88.8%): primarily frozen products and canned products. • manufacturing and sale of fine chemical products (3.7%): pharmaceutical raw materials, functional raw materials, functional foods, pharmaceutical products, and clinical diagnostic products:. • transportation, cold storage and warehousing services (2.3%). • - others (5.2%): primarily construction, operating and repair of vessels.	HI	89	1,370	Japan/Asia	https://www.marketscreener.com/NIPPON-SUISAN-KAISHA-LTD-6491177/company/
24	Norway Royal Salmon	Norway Royal Salmon ASA is a Norway-based fish farming company. The company has activities in two main segments, namely, fish farming and sales. The sales segment includes the purchase and sale of salmon. The fish farming business includes salmon farming and harvesting activities. Norway Royal Salmon is involved in all stages of the process: production, harvesting, sales, and marketing of salmon and trout. The companies' product offering includes fresh and frozen salmon and trout. Its products were sold to customers in 49 countries worldwide in 2013. Most of the companies' products are sold in Western Europe, Eastern Europe, Russia, Asia, and the Middle East. As of December 31, 2013, the Company had four subsidiaries that owned a total of 25 licenses. Additionally, it held minority interests in seven companies, three of which are fish farming companies, three are harvesting plants, and two are smolt companies. As of December 31, 2013, its largest shareholder was Gaso Naeringsutvikling AS.	LO	34	1,053	Norway/Europe	https://www.marketscreener.com/NORWAY-ROYAL-SALMON-AS-7693171/company/
25	OUG Holdings	OUG Holdings Inc. is a Japan-based company mainly engaged in the wholesale of seafood. The company operates in five business segments. The marine products contract segment is engaged in the sale of marine products on the wholesale market based on the Wholesale Market Law. The off-market marine products wholesale segment is engaged in the sale of marine products outside the wholesale markets. The aquaculture segment provides fresh fish. The food processing segment is engaged in the processing of foods, mainly marine products. The logistics segment provides logistics mainly for marine products. The company is also engaged in insurance agency and leasing business,	HI	98	131	Japan/Asia	https://www.marketscreener.com/OUG-HOLDINGS-INC-13620661/company/

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		seafood wholesale and seafood retail, and other businesses that complement the distribution of seafood.					
26	Pacific Andes International Holdings	Established in 1986 and listed on the Mainboard of Hong Kong Stock Exchange in 1994, Pacific Andes International Holdings Limited ("Pacific Andes") is a fully integrated group of companies with operations across the entire seafood value chain that includes harvesting, sourcing, ocean logistics and transportation, food safety testing, processing, and distribution of frozen fish products, as well as fishmeal and fish oil. The group's businesses span across the world with particular emphasis in the China market, while it has processing factories located in China, Japan, United States, and Peru. Pacific Andes' resource development and supply chain management division, Pacific Andes Resources Development Limited, and its industrial fishing arm, China Fishery Group Limited, were listed on the Singapore Exchange in 1996 and 2006, respectively.	HI	57	NA	China/Asia	https://www.fis.com/fis/companies/details.asp?l=e&filterby=companies&=&country_id=&page=1&company_id=31264&submenu=info
27	Pescanova	Pescanova SA is a Spain-based company primarily engaged, through its subsidiaries, in the fishing industry. The company comprises the farming, capturing, cleaning, cutting, freezing, processing, and packaging onboard factory ships, as well as the transport, distribution, and marketing of a variety of fish products. The companies' activities are structured in three business areas: wildcatch, where fish and shellfish are processed and frozen immediately after being caught; farmed fish, mainly involved in aquaculture operations and the development of technology for the fishing activities; and food products, which offers deep-frozen fish and shellfish products. The company is a parent of Grupo Pescanova, a group that comprises a number of controlled entities with operations established worldwide. In March 2013, the company entered bankruptcy proceedings. In December, 2013, the Company completed the sale of a 50% stake in Austral Fisheries Pty Ltd. to Maruha Nichiro Seafood Inc.	HI	100	14	Spain/Europe	https://www.marketscreener.com/PESCANOVA-S-A-74977/
28	Pesquera Camanchaca	Cia Pesquera Camanchaca SA is a Chilean company primarily engaged in the fishing sector. The Company operates in two business divisions: aquaculture and fishing. Its main activities comprise investigation; aquaculture of all kinds of marine species; freezing and preservation of aquatic species; construction, maintenance, repair, operation, and	HI	70	309	Chile/America	https://www.marketscreener.com/COMPA-A-PESQUERA-CAMANCH-20706466/company/

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		rental of fishing boats; and processing, marketing and distribution of the products. The companies' products include salmon and steelhead trout, mussels, abalone, scallops, langostino lobster tails, fishmeal, fish oil, and canned jacked mackerel. Cia Pesquera Camanchaca SA is a parent company of the Grupo Camanchaca, which is formed by such subsidiaries as Salmones Camanchaca SA, Fiordo Blanco SA, Cultivos Marinos del Pacifico SA, Transportes Interpolar Ltda, and Camancha SpA, among others. The company distributes its products on domestic, as well as international market, primarily in North America, Asia, and Europe.					
29	Sajo	SAJO INDUSTRIES CO. LTD is a Korea-based company engaged in fishery business and the production of seafood-related products. The company and its subsidiaries operate six business divisions: deep-sea fishing division, which provides tunas, including bluefin tunas, bigeye tunas, yellowfin tunas, albacore tunas, marlins, and others; food division, which provides processed seafood products, such as tuna cans, saury and mackerel cans, and red pepper pastes, as well as hams and sausages; pig farming division, which provides live pigs; leisure division, which operates golf courses; and other divisions, which provide refrigerated warehousing services and others. The company distributes its products within domestic market and to overseas markets.	LO	27	119	Korea/Asia	https://www.marketscreener.com/SAJO-INDUSTRIES-COMPANY-L-9060048/company/
30	Salmar	SalMar ASA is one of the world's leading producers of salmonids. Net sales (including intragroup) breakdown by activity as follows: • processing and sales of farmed salmon and trout (93.3%). • salmonid farming (6.7%): producing, in 2019, 153 Kt of fish. At the end of 2019, the group owns 126 fish farming licenses in Norway.Net sales are distributed geographically as follows: Norway (17.7%), Europe (41.3%), Asia (22.9%), the United States and Canada (17.4%), and others (0.7%).	HI	93	5,058	Norway/Europe	https://www.marketscreener.com/SALMAR-ASA-1413264/company/
31	Sanford	Sanford Limited is a seafood company, which is engaged in farming, processing and aquaculture business. The company's segments include wildcatch, which is responsible for catching and processing inshore and deep-water fish species, and aquaculture, which is responsible for farming, harvesting, and processing mussels and salmon. The	HI	100	394	New Zealand/Asia	https://www.marketscreener.com/SANFORD-LIMITED-6491409/company/

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		company's farming business includes Fleet, which operates a fleet of vessels for inshore, purse seine and deep water fishing, including vessels for freezing and processing at sea. The company's aquaculture business includes mussel farming, oyster farming, and king salmon farming. The company's sea food products include Antarctic toothfish arrow squid, blue mackerel, bluff oyster, gemfish, ghost shark, hake, hapuku, hoki, jack mackerel, John dory, kahawai, king salmon, lemon sole, ling, monkfish, orange roughy, Patagonian toothfish, red cod, scampi, silver warehou, snapper, trevally, and yellowbelly flounder.					
32	Sojitz	Sojitz established Sojitz Tuna Farm Takashima Co., Ltd. in September 2008 as a bluefin tuna farmer. Sojitz was the first major trading company to invest directly in the tuna farming business in Japan. Sojitz's fisheries business has long been the major trader in Japan in the field of imported frozen tuna for sashimi. Sojitz, however, felt a sense of crisis concerning international fishing regulations, and supplies decreased because of falling bluefin tuna resources. This was the background to the company launching a farming business. "Trading companies must promote the farming business in order to secure aquatic resources for stable supply," says Junya Hanzawa, who was in charge of the project when Sojitz Tuna Farm Takashima was established. Sojitz already dealt in farm-fattened bluefin tuna from the Mediterranean Sea and accumulated knowledge that could be utilized for farming, which prompted the company to start the business.	LO	7	2,827	Japan/Asia	https://www.sojitz.com/en/news/2008/09/20080908.phphttps://www.marketscreener.com/SOJITZ-CORPORATION-6496186/company/
33	Thai Union Group	Thai Union Group Public Company Limited, formerly known as Thai Union Frozen Products Public Company Limited, is a Thailand-based company engaged in the manufacture and export of frozen and canned seafood. The company's operations are divided into five groups: production and export of frozen and canned food products, production and distribution of packaging products, production and distribution of animal feeds and agriculture products, food business in domestic market, and overseas investment. Its exported products include canned, pouched, and seal-contained tuna, sardine, mackerel, and seafood, frozen shrimp, and frozen tuna loin, among others. The company distributes fish- and squid-based snacks, canned tuna, and pet food under the brand names Fisho, Sealect, and Bellotta,	LO	40	1,903	Thailand/Asia	https://www.marketscreener.com/THAI-UNION-GROUP-24025904/company/

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		respectively. Its subsidiaries comprise Songkla Canning PCL., Thai Union Manufacturing Co., Ltd., Thai Union Seafood Co., Ltd., T-Holding Co., Ltd., and Thai Union Feedmill Co., Ltd., among others					
34	Tohto Suisan	TOHTO SUISAN CO., LTD. is a Japan-based company engaged in the wholesale of seafood, the purchase and sale of fresh, and processed marine products on the wholesale market, as well as the refrigerated warehousing, the manufacture and processing of marine products, real estate leasing, and other businesses. The company has three business segments. The seafood wholesale segment is involved in the wholesale of seafood. The refrigerated warehouse and related segment is engaged in the refrigerated warehousing business, as well as the manufacture and processing of seafood. The real estate leasing segment is engaged in the leasing of real estate properties and the establishment of wholesale markets.	HI	93	123	Japan/Asia	https://www.marketscreener.com/TOHTO-SUISAN-CO-LTD-6495042/company/
35	Toyo Suisan Kaisha	TOYO SUISAN KAISHA, LTD. is a Japan-based food manufacturing company. The company operates in six business segments. The seafood segment is engaged in the purchase, processing, and sale of seafoods in domestic and overseas markets. The overseas instant noodles segment provides cup and bag noodles mainly in the United States and Mexico. The domestic instant noodles segment provides cup and bag noodles in Japan. The low-temperature food segment manufactures and sells steamed and roasted buckwheat noodles, raw ramen, boiled noodles, frozen noodles and commercial cocking products. The prepared food segment is engaged in the manufacture and sale of sterile packaged rice, retort rice, soup, and other foods. The frozen and cold storage segment is engaged in the provision of storage and freezing services. The company also involves in the bag lunch and prepared food businesses.	HI	79	5,397	Japan/Asia	https://www.marketscreener.com/TOYO-SUISAN-KAISHA-LTD-6492148/company/
36	Trident Group	Founded in 1973 by fishermen Chuck Bundrant today, Trident's value-added processing facilities in Anacortes, Bellingham, and Seattle, Washington, turn out an ever-increasing selection of finished, ready-to-prepare seafood items for US foodservice and retail distribution Something is “supposed” to be fishy at Trident Seafoods. The vertically integrated seafood business hauls in salmon, crab, and assorted other fin and shell fish from the icy waters of Alaska and the Pacific Northwest, then processes	LO	0	2,321	USA/America	https://www.fis.com/fis/companies/details.asp?l=e&filterby=companies&=&country_id=&page=1&company_id=45733&submenu=info

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		and cans or freezes them for retail and foodservice customers. The #2 North American seafood supplier in 2008, (behind Tri Marine). Trident Seafoods operates a fleet of some 30 processing boats and trawlers, as well as about a dozen onshore processing plants. The company's brands include Trident, Louis Kemp, and SeaLegs brand of surimi (crab-flavored processed fish). Trident also owns Port Chatham Smoked Seafood, which smokes salmon and tuna as gift products under the Portlock label. Canned brands: Lily, Rubenstein, Prelate, Tulip, Royal, Sea Alaska, Whitney, Sno Tip, Faust, and Bear & Wolf.					
37	Triton Group	The Triton Group comprises a group of companies with business interests in the fields of seafood distribution, trade, process, and produce. Triton Group's full-service approach to the seafood business allows to consistently provide quality products to its customers in various continents. The company has over 15 years of experience in the industry and has built a very strong customer and supplier base. Triton Group fulfills the market demand distributing whole round frozen and fish of various marine species including herring, mackerel, horse mackerel, blue whiting, sardines, prawns, shrimps, and many more. The Triton Group also distributes pelagic fish and seafood in various countries. The group's large cold-store capacities and fleet of refrigerated trucks help to efficiently support the supply chain for such high volumes. Triton Group products are well-known for their quality. The processing facility in India is HACCP (Hazard Analysis and Critical Control Point) and BRC (British Retail Consortium) certified. It is also FDA (US Food and Drug Administration) "A" listed and conforms to the EU (European Union) standards. The Group is in process of expanding its operations to various countries in Africa and Europe for distribution of pelagic and value added products. The current cold storage capacity will be enhanced by another 30% in India and Africa in the near future. Triton Group's ambitious plan of setting up cold stores at supply side will enable it to procure and distribute products throughout the year. Triton Group is also developing novel technologies in aquaculture. The group has adopted various new methods of aquaculture in India and has acquired	LO	11	2,160	India/Asia	https://www.fis.com/fis/techno/newtechno.asp?id=39874&l=e&ndb=1

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		various water bodies. The major species that are cultured in India are IMC, tilapia, pangasius, pacu, black tiger, and scampi. The group also has started initiatives of aquaculture in Ghana.					
38	Tsukiji Uoichiba	TSUKIJI UOICHIBA COMPANY, LIMITED is mainly engaged in the wholesale business of marine products and the purchase and sale of marine products, refrigerated warehouse business, and real estate leasing as ancillary businesses. The company operates in three segments. The seafood wholesale segment is engaged in consignment, processing, and purchase sale of freshly processed marine products. The refrigerated warehousing segment is refrigerated storage of marine products, refrigerated warehousing business and carrying work in the refrigerator. The real estate segment is engaged in the owning and rental of real estate.	LO	0	19	Japan/Asia	https://www.marketscreener.com/TSUKIJI-UOICHIBA-COMPANY-6495247/company/
39	Yokohama Gyorui	YOKOHAMA GYORUI CO., LTD. is a Japan-based company mainly engaged in the sale and process of marine products. The marine products wholesale business is engaged in the wholesale business of marine products and related products at Yokohama City Central Wholesale Market and Kawasaki City Central Wholesale Market Northern Market. The marine products processing business is engaged in the process of marine products.	LO	21	30	Japan/Asia	https://www.marketscreener.com/YOKOHAMA-GYORUI-CO-LTD-14116137/company/
40	Yokohama Maruuo	Yokohama Maruuo Co., Ltd. is engaged in the wholesale of marine products. The company operates in four business segments. The marine product wholesale segment is engaged in the wholesale of marine products in central wholesale markets located in Yokohama and Kawasaki cities, as well as regional wholesale markets in Kawasaki city. The marine product sale segment is engaged in the purchase of marine products from central wholesale markets, as well as the sale of marine products mainly to general merchandising stores and restaurant industry. The real estate leasing segment is engaged in the leasing of rental condominiums. The transportation segment is engaged in the transportation of marine products.	LO	20	54	Japan/Asia	https://www.marketscreener.com/YOKOHAMA-MARUUO-CO-LTD-14116236/company/
41	Yokohama Reito	YOKOHAMA REITO CO.,LTD. is a Japan-based company mainly engaged in the refrigerated warehouse business and	LO	20	502	Japan/Asia	

(Continues)

TABLE D1 (Continued)

#	Firm	Description	Aquaculture[a]		Market capitalization (US$ million)	Country/continent	Source
			HI/LO	%			
		food sales business of marine products, livestock products, and agricultural products. Refrigerated warehouse segment is involved in the provision of chilled and refrigerated storage for marine products and livestock products, as well as the provision of related business. Food sales segment is involved in the wholesale and processing of marine products and livestock products. Others segment is involved in the real estate leasing business.					https://www.marketscreener.com/YOKOHAMA-REITO-CO-LTD-6493439/company/
42	Zhanjiang Guolian	ZHANJIANG GUOLIAN AQUATIC PRODUCTS CO., LTD is a China-based company principally engaged in the cultivation, processing, trading, research, and development of aquatic products. The company's main products include prawns and tilapia seedlings, aquatic feed, first processed products, and processed foods and others. The company distributes its products in domestic and to overseas markets.	HI	93	499	China/Asia	https://www.marketscreener.com/ZHANJIANG-GUOLIAN-AQUATIC-9060020/company/

[a]Firms are divided into two groups: those within 50% highest share of aquaculture in total turnover (HI) and those within 50% lowest share (LO); the percentage relates to the estimated size of aquaculture in turnover in the latest year available, where latest year can be found with source column.

APPENDIX E.

TABLE E1 Comparing disaster events: spills and earthquakes

	Spills			Earthquakes			Difference: earthquakes–spills		
Day	AAR	Par. test *p* value	Nonpar. test *p* value	AAR	Par. test *p* value	Nonpar. test *p* value	AAR	Par. test *p* value	Nonpar. test *p* value
−3	0.0065	0.8315	0.4934	−0.0011	0.4412	0.2395	−0.0018	0.5655	0.7337
−2	0.0012	0.5472	0.4934	0.00006	0.7523	0.9755	−0.0006	0.8394	0.9062
−1	0.0032	0.2114	0.4522	0.0035	0.1772	0.2130	0.0002	0.9396	0.8047
0	−0.0047	0.1169	0.0109	−0.0024	0.0969	0.2231	0.0023	0.4464	0.1108
1	0.0027	0.1958	0.2435	−0.0243	0.0000	0.0000	−0.0270	0.0000	0.0000
2	−0.0014	0.4769	0.2435	−0.0229	0.0000	0.0344	−0.0215	0.0060	0.4827
3	−0.0016	0.5163	0.1184	0.0125	0.0020	0.0292	0.0141	0.0065	0.0172
Period	CAAR	Par. test *p* value	Nonpar. test *p* value	CAAR	Par. test *p* value	Nonpar. test *p* value	CAAR	Par. test *p* value	Nonpar. test *p* value
[0, 3]	−0.0051	0.3090	0.2625	−0.0372	0.0000	0.0000	−0.0320	0.0036	0.0463
[1, 3]	−0.0003	0.9275	0.7417	−0.0348	0.0000	0.0000	−0.0344	0.0007	0.0042

Abbreviations: AAR, average abnormal return; CAAR, cumulative average abnormal return.

TABLE E2 Comparing policy events: positive and negative policy announcements

	Positive announcement			Negative announcement			Difference: positive–negative		
Day	AAR	Par. test *p* value	Nonpar. test *p* value	AAR	Par. test *p* value	Nonpar. test *p* value	AAR	Par. test *p* value	Nonpar. test *p* value
−3	−0.0017	0.4933	0.5186	0.0061	0.1336	0.1109	−0.0078	0.0840	0.0835
−2	0.0028	0.1593	0.2645	−0.0017	0.5635	0.7605	0.0045	0.1787	0.4456
−1	−0.0015	0.4473	0.3412	−0.0030	0.3635	0.6443	0.0014	0.6913	0.5060
0	0.0006	0.7568	0.9738	−0.0028	0.3985	0.9514	0.0034	0.3471	0.9066
1	−0.0036	0.1329	0.0570	0.0029	0.3489	0.1556	−0.0066	0.0902	0.0180
2	0.0008	0.7303	0.6776	−0.0010	0.7377	0.5476	0.0019	0.6262	0.4514
3	−0.0011	0.6748	0.2205	0.0053	0.1325	0.2260	−0.0064	0.1388	0.1066
Period	CAAR	Par. test *p* value	Nonpar. test *p* value	CAAR	Par. test *p* value	Nonpar. test *p* value	CAAR	Par. test *p* value	Nonpar. test *p* value
[0, 3]	−0.0033	0.4807	0.3357	0.0043	0.4833	0.1826	−0.0077	0.3177	0.1131
[1, 3]	−0.0039	0.3809	0.1683	0.0070	0.0951	0.0997	−0.0111	0.0570	0.0299

Abbreviations: AAR, average abnormal return; CAAR, cumulative average abnormal return.

TABLE E3 Comparing with the firms: aquaculture

	Aquaculture (HI)			Aquaculture (LO)			Difference: HI–LO Aquaculture		
Day	AAR	Par. test *p* value	Nonpar. test *p* value	AAR	Par. test *p* value	Nonpar. test *p* value	AAR	Par. test *p* value	Nonpar. test *p* value
−3	0.0016	0.6030	0.7657	0.0016	0.4090	0.3935	−0.0003	0.9939	0.6270
−2	0.0011	0.6262	0.4200	0.0003	0.8350	0.4873	0.0007	0.8397	0.8517
−1	−0.0027	0.2925	0.4292	−0.0009	0.2656	0.3718	−0.0017	0.6687	0.6422
0	−0.0011	0.6473	0.7840	−0.0001	0.8281	0.4628	−0.0010	0.7916	0.9361
1	−0.0013	0.5349	0.6364	0.0004	0.9102	0.1265	−0.0018	0.6698	0.8601
2	−0.0009	0.7126	0.7840	0.0023	0.3710	0.9210	−0.0032	0.4475	0.6653
3	0.0025	0.3672	0.8769	−0.0008	0.7585	0.9525	0.0034	0.4798	0.9361
Period	CAAR	Par. test *p* value	Nonpar. test *p* value	CAAR	Par. test *p* value	Nonpar. test *p* value	CAAR	Par. test *p* value	Nonpar. test *p* value
[0, 3]	−0.0008	0.8566	0.9462	0.0018	0.7238	0.9842	−0.0027	0.7461	0.8769
[1, 3]	0.0002	0.9511	0.7962	0.0019	0.6895	0.9842	−0.0016	0.8307	0.7446

Abbreviations: AAR, average abnormal return; CAAR, cumulative average abnormal return.

TABLE E4 Comparing spills and earthquakes for companies high or low in aquaculture

	Spills			Earthquakes			Difference: spills–earthquakes		
Aqua- HI	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric
−3	−0.0067	0.0430	0.1124	−0.0018	0.5188	0.3946	0.0049	0.2536	0.5734
−2	−0.0022	0.5171	0.8918	−0.0019	0.5264	0.4024	0.0002	0.9572	0.6545
−1	−0.0024	0.6032	0.9535	0.0085	0.0861	0.0655	0.0110	0.1073	0.1672
0	−0.0088	0.2342	0.3029	−0.0043	0.1022	0.3644	0.0043	0.5704	0.8587
1	0.0058	0.1636	0.0543	−0.0241	0.0005	0.0003	−0.0299	0.0001	0.000
2	0.0005	0.8884	0.8408	−0.0256	0.0118	0.0697	−0.0261	0.0119	0.1921
3	−0.0031	0.6434	0.4562	0.0153	0.0097	0.0295	0.0184	0.0403	0.0458
	Spills			Earthquakes			Difference: spills–earthquakes		
Aqua-LO	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric
−3	0.0039	0.2921	0.6235	−0.0009	0.5699	0.3390	−0.0048	0.2311	0.4270
−2	0.0016	0.3991	0.1238	0.0031	0.2835	0.1488	0.0014	0.6773	0.1026
−1	0.0022	0.4401	0.6778	0.0005	0.8465	0.9030	−0.0017	0.6682	0.9013
0	−0.0026	0.4274	0.0336	−0.0011	0.4868	0.5057	0.0015	0.6827	0.2972
1	0.0010	0.6141	0.4333	−0.0264	0.0010	0.0001	−0.0274	0.0006	0.0022
2	0.0012	0.5065	0.5647	−0.0224	0.0215	0.2489	−0.0236	0.0157	0.6034
3	−0.0003	0.7999	0.0966	−0.0109	0.0747	0.2810	0.0113	0.0709	0.1040
−3	0.0039	0.2921	0.6235	−0.0009	0.5699	0.3390	−0.0048	0.2311	0.4270

Abbreviation: AAR, average abnormal return.

TABLE E5 Comparing negative and positive policy shocks for companies high or low in aquaculture

	Positive announcement			Negative announcement			Difference: positive–negative		
Aqua-HI	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric
−3	−0.0031	0.3033	0.3590	0.0091	0.1487	0.1396	−0.0012	0.0500	0.0617
−2	0.0029	0.2402	0.4035	−0.0017	0.7007	0.7826	0.0047	0.3246	0.7931
−1	−0.0016	0.5449	0.5230	−0.0044	0.3985	0.6378	0.0027	0.5976	0.7184
0	0.0010	0.6793	0.6942	−0.0047	0.3678	0.8583	0.0058	0.2692	0.6700
1	−0.0029	0.3128	0.2449	0.0011	0.7392	0.3065	−0.0041	0.3689	0.1897
2	−0.0009	0.7127	0.4222	−0.0008	0.8719	0.6148	−0.0001	0.9707	0.3174
3	−0.0001	0.9961	0.2870	0.0067	0.2061	0.3221	−0.0067	0.2521	0.1843
	Positive announcement			Negative announcement			Difference: Positive – Negative		
Aqua-LO	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric	AAR	Parametric	Nonparametric
−3	0.0027	0.5127	0.5892	0.0005	0.3388	0.3173	0.0021	0.5868	0.8734
−2	0.0025	0.4161	0.2197	−0.0016	0.3388	0.3173	0.0042	0.2238	0.0797
−1	−0.0014	0.4240	0.5234	−0.0005	0.3388	0.3173	−0.0008	0.6224	0.8734
0	−0.0008	0.2269	0.1850	0.0005	0.3388	0.3173	−0.0014	0.1176	0.0797
1	−0.0058	0.1678	0.0272	0.0061	0.3388	0.3173	−0.0120	0.1231	0.0086
2	0.0065	0.2001	0.5234	−0.0015	0.3388	0.3173	0.0081	0.1085	0.3809
3	−0.0047	0.3027	0.5234	0.0027	0.3388	0.3173	−0.0008	0.1538	0.3809

Abbreviation: AAR, average abnormal return.